

SCIENCE

FRIDAY, FEBRUARY 17, 1888.

FOR MONTHS PAST the attention of university men throughout the country has been centred in the Princeton College Board of Trustees, who were deliberating as to the successor of Dr. M'Cosh in the presidency of that institution. On Thursday, Feb. 9, the fruit of those deliberations was seen in the unanimous election of Francis L. Patton, D.D., to the vacant post. This choice is on all grounds to be warmly commended. Dr. Patton is still a young man, being but forty-five years of age, and has yet to put forth to their fullest extent his marvellous intellectual powers. We seriously question whether any college has a president of so high an intellectual stamp as Dr. Patton. His theological and philosophical learning is vast in extent, and rich in quality. Both with tongue and pen he is clear and incisive. His critical ability is unrivalled, and in his new position he will have ample opportunity to show whether or not he is equally strong in constructive and administrative power. To follow Dr. M'Cosh is a trying test for any one, but we feel sure that Dr. Patton will confer honor and credit both upon Princeton and upon himself in his administration. That it may be long and prosperous, and that Dr. M'Cosh may long be spared to witness the carrying-on of the work that he has so wisely planned, is the hearty wish of every friend of higher education in this country.

SCIENCE IN ELEMENTARY SCHOOLS.

IN the report of the council of education (England and Wales) for 1887, there are some excellent remarks about elementary science-teaching which are reproduced in a recent number of *Nature*. The judgment is passed that nothing could be more unsatisfactory than the present position of the knowledge and teaching of science in the elementary schools. Notwithstanding all the advantages that have been offered pupil-teachers for the study of science, as a body they appear to be in a most deplorable state in this respect. The inspector who reports on training-colleges finds the ordinary pupil-teacher deficient even in mathematics. It is in doubt whether this deficiency should be ascribed to poor teaching or defective early training. Mr. Fitch, who reports on female training-colleges, finds things no better there. At the admission examination the work in the arithmetic is satisfactory in point of accuracy, but it displays want of method, failure to appreciate the meaning of the question asked, and ignorance of principles. Thus very few of the candidates were able to give an intelligent explanation of simple arithmetical processes, such as subtraction or division. With them, as with the male pupil-teachers, book-work and memory are wholly relied on, and little attention is paid to the intelligent application of principles. "Scarcely three per cent are able to do much more in the teaching of arithmetic than work sums more or less correctly on the blackboard."

With such material to work on, it is not surprising that the results of the work at the colleges are not what they otherwise might be. Those who are below the average at admission rarely succeed very well in the array of subjects to be learned in two years' training. With regard to the male students, the reports at the close of the first year's training record that the answering of the questions set on the first book of Euclid was disappointing. The students appear to have learned their propositions by rote, and to have displayed great want of neatness and accuracy. Though the riders were joined to the propositions on which their solution depended and though all these riders were easy, very few of the papers were satisfactory. This inability to solve the easiest geometrical deductions is commented on again and again, and proves beyond doubt

that either the students are negligently taught, or that they commit the book-work to memory without understanding it, and consequently are quite incapable of applying their knowledge to solve the simplest riders.

In summing up his impressions of the male training-colleges, the inspector gives it as his opinion that the students are over-lectured at some of the colleges, and that the lectures are mechanically reproduced, and transferred as closely as possible to the examination papers. This, of course, is due to the defective early training of the students, and to lectures injudiciously delivered on subjects about which students know absolutely nothing. For instance: one lecturer delivered a very excellent discourse on the corrupt form of Latin used by the Roman soldiers in Britain, its causes and its effects, to a class of which few, if any, of the members knew any thing whatever of Latin.

In the female colleges, even in arithmetic, questions on theory and principles are not well done, long problems are inaccurately done, and, as a whole, it is seen that there is yet much that remains before it can be said that the present system is satisfactory as regards the knowledge given and the methods adopted. There appears to be among the students a very narrow view of their future work, a desire to regard the obtaining of their certificates as the goal and aim of their existence. The views on science, of one of these maidens, are worth recording: "If I am successful in obtaining my certificate, I intend (D.V.) going in for two sciences. At the same time I propose attending a tonic-sol-fa class to get my advanced certificate. Should the two sciences 'sound, light, and heat,' and 'electricity and magnetism,' prove a success, I shall probably take up the science of hygiene." If the training-colleges tend to remove the impression that the technical qualification is the end of the pupil-teacher's work, if they awaken a spirit of emulation among the students, and enable them to teach more thoroughly and intelligently, then they will have fulfilled a large portion of their duties.

With such products as are thus indicated, as teachers, it is easy to predict what the schools that are under their care will be like. With masters, the majority of whom know little or nothing of even the elements of science, the pupils cannot be expected to pass well in these subjects. Thus it is seen, in the return of the number of pupils sent up on 'specific subjects' (most of which are scientific), that only 16.51 of those eligible for examination have been so examined, and of these nearly one-half were from the London School Board District. One-half of the passes were in algebra and animal physiology.

The inspectors in all parts of the Kingdom agree, that, with the exception of some of the cities and large towns, throughout the elementary schools science is untaught. This we can well imagine, when we have seen that the average teacher is completely ignorant of any of its branches, and it is the average teacher who is sent to the country schools. The explanation of some of the inspectors, that in the country for a great portion of the year the attendance of the children who are fit to be taught these subjects is very irregular, does not meet the question; for, even were the children most regular in their attendance, the subjects could not at present be taught, and, until the average elementary teacher is altered, they will not be taught.

The brightest spot of all appears to be Nottingham, and there 2,526 children were examined in specific subjects, of whom four-fifths passed. "Mechanics for boys, and domestic economy for girls, are the subjects principally taken by the Nottingham Board Schools, and are taught by a specially qualified science demonstrator and assistant, who visit the various schools in turns, bringing the apparatus with them in a specially constructed hand-cart. The lectures given on these occasions are afterwards gone through again by the teachers of the schools, from notes taken at the time. These lectures are simple and interesting, and are given with great

care and skill. The results are remarkably good, both as regards the actual knowledge acquired by the scholars, and the stimulus given to the general intelligence. Besides the above-named subjects, physiology and algebra are often taken with very good results, and in one school the principles of agriculture are taught with marked success."

Some of the causes of this almost total absence of any scientific teaching in the elementary schools have been pointed out. Where science has been well taught, it has borne good fruit; and where teachers and managers have set themselves steadfastly to overcome the difficulties in their way, a high and encouraging measure of success has been obtained. Thus we have the remarkable testimony of the success of the experiment in Nottingham, and surely there are many other districts in England quite as competent to carry on this work as Nottingham. Why it could not be done in any town in England, it is difficult to see. In many cases where these subjects have been taught, the inspectors have wisely set their faces against them, finding but a wretched smattering among the pupils. Nothing else can be expected in remote rural districts, where the teacher, whose whole time is scarcely sufficient for the few rudimentary subjects, is so ambitious as to attempt to cram some of his pupils with the elementary knowledge of a science of which he is himself confessedly ignorant. But in the towns and cities competent teachers are always to be had. If the board masters do not find themselves fit for the extra labor and extra knowledge required, there should be no difficulty in obtaining a specialist, as has been done at Nottingham. And in no place could the foundations of technical education be more surely laid than among the elder children of elementary schools. In the minutes and instructions issued to her Majesty's inspectors, managers are requested to aid, in every way they can, the teaching of one or more specific subjects appropriate to the industrial or other needs of the locality, and the rudiments of two higher subjects to supply a foundation for future work. With this object, it is suggested that where the teacher is not competent to do so, — and this, according to the reports, is the rule, and not the exception, — a specialist might be employed by a number of schools in a district, whose instruction would be supplemented by that of the ordinary teachers. There is only one instance, that of Nottingham, given in the reports, of such suggestions having been followed.

What is said in the report about geography and geography-teaching is of special interest. It appears that while there is a great absence of culture and general intelligence upon the part of a considerable number of candidates, yet the answers to the geography-papers set for admission to the male training-colleges are more accurate than would be supposed.

Here, again, the metropolitan candidates are superior to the provincial candidates, particularly in the map-drawing, though in this particular there has been a falling-away of late. Among the female candidates, the geography was not very satisfactory, exhibiting inaccuracies in map-drawing, indefiniteness in the answers, and generally marks of defective early training. In the examinations for the first year's certificates the male candidates answered fully and accurately; but usually there was a slavish following of the words of the text-books and the lecturers' notes. At the end of the second year there is the same report, — book-knowledge without intelligence, and abundance of information imperfectly digested. With the females the result is the same, — verbatim reproduction of the books or notes they had read; fairly creditable answering; but "the style of the papers reveals the painful poverty of the general reading of the students, and the utter absence of any individuality, or attempt at description in their own words." In many papers there was a constant iteration of the same words and phrases, suggesting that the candidates had learned off by rote the answers to probable questions. With regard to the elementary schools, all the reports agree in saying that there has been a marked improvement in the teaching of geography. Where it is intelligently taught, it is the favorite subject; but too frequently the children are not well grounded. While all parts of the country report progress in geography, it is worthy of remark that all the maritime districts surpass the inland schools in the knowledge of the country, its colonies, and its trade. The report believes that this is only natural, and insists that "the teacher who would not, in Devonshire, interest a class of

boys in the voyages of Drake, or who, in Somerset, would not rivet the attention of his pupils on the victories of Blake, would not be worthy of his post." Though the teachers may be congratulated, speaking generally, on the progress made in geography, there are many faults to be found. In portions of Wales and of the centre of England, geography is only fairly satisfactory. The pupils are weak in questions of latitude and longitude: they do not learn intelligently, because most probably they are taught mechanically and unintelligently. It should be within the power of every teacher, by the use of an ordinary globe, to make this portion of the subject intelligible to any ordinary boy. But few lads could understand a lesson on meridians and parallels, given by a teacher who does not use a globe at all; and yet this is quite common. Hence it is that the map-drawing is very poor, even where there is a good knowledge of geographical facts. Many of the inspectors complain of lack of globes, maps, etc.; and, even where there is abundance of general maps, there are no local maps, — a want which is very widely felt. In this respect the Board of Education might take a lesson from the commissioners of national education in Ireland, who have published local maps, and require each pupil in the higher grades to know, in addition to general geography, the map of his neighborhood.

THE IMPROVEMENT OF HARBOR ENTRANCES.

IN 1743, under the direction of Dr. Benjamin Franklin, a movement was started in Philadelphia for the organization of the first scientific society in America; and in a letter from Franklin, under date April 5, 1744, to his friend "Hone Cadwallader Colden, Esq.," he says, "The Society, as far as relates to Philadelphia, is actually formed, and has had several Meetings to mutual Satisfaction; — as soon as I get home, I shall send you a short Acct. of what has been done and proposed at these meetings."

This society, which for nearly a century and a half has been known as the 'American Philosophical Society for the Promotion of Useful Knowledge,' has been presided over by the most distinguished of American scientists and scholars, and an election to its membership has been an honor cherished no less by foreigners than by Americans. The society to-day is venerated for its age, distinguished for its services in promoting useful knowledge throughout the continent, and claims for its supporters the greatest scientists, the most cultured scholars, and the most prominent of American engineers who have been active in the dissemination of useful knowledge through improved navigation, the creation of canal and railway systems, the telegraph, and the development of the mechanic arts, by which useful knowledge has become as free to all as the air we breathe.

In 1785 John Hyacinth de Magellan of London, recognizing the prominent position of the society, proposed to donate to the society "200 guineas, to be appropriated as a perpetual Fund; the interest of which to be annually given, in a medal of gold, as a Premium to the author of the best Discovery, or most useful Improvements relating to Navigation or Natural Philosophy." The conditions under which this premium was to be awarded were drafted by a committee of which Dr. Franklin was a member, and were approved by Magellan himself. These conditions are so exacting that but few discoveries have been considered sufficiently important in themselves to merit the high honor of the 'Magellanic Medal,' — an American honor which is esteemed more highly than any to be won by a scientific discoverer in the field of navigation, natural philosophy, or astronomy; which latter subject Magellan subsequently included. It has now been many years since any discoverer has received this medal, although applications are continually presented which seek the prize so zealously guarded by the society.

Last spring a paper was presented to the society, describing a most important discovery in ocean dynamics, under the title 'The Physical Phenomena of Harbor Entrances, their Causes and Remedies. — Defects of Present Methods of Improvements.' This, with other communications, was referred to the consideration of the twelve counsellors and other officers of the society, and on Dec. 16 a favorable report on the discovery was made to the society, and, by a secret ballot of the members, the premium was awarded the same. Upon opening the sealed letter with the same motto as that accompanying the description of the discovery, it was found that

the premium had been awarded Lewis M. Haupt, professor of civil engineering at the University of Pennsylvania. This discovery of authorship was a surprise to the society, since it was thought that the author of the paper would have proved to be a member of the Coast and Geodetic Survey, of the Hydrographic Office, or of the River and Harbor Improvement Service, a number of the members of which have given much attention to the laws of ocean dynamics in determining the improvements to be made annually by the government to our rivers and harbors. The mere announcement, however, of Professor Haupt's name was confirmatory evidence of the wisdom of the society in awarding the medal. Professor Haupt, although an engineer graduate of West Point, has, during the past twenty years of civil professional life as an engineer, won such success and distinction in his profession, that the present honor which he has received only re-enforces the views which are gaining such a stronghold, — that the civilian engineer merits a standing in all government engineering work on the same basis as the regularly commissioned officers.

Tersely, the object of the paper presented to the society was to collate certain observed facts for the purpose of explaining the physical phenomena of harbor entrances, and of deducing therefrom conclusions of practical value in the economical solution of the problem of improving the channels and shelterings of harbors.

What was claimed in the paper as meriting the favorable judgment of the society is briefly outlined by the author as follows: —

"1. The determination of the character, direction, and relative intensities of the forces acting upon any harbor entrance, from a study of the submerged topography and other local physical features.

"2. The discovery of the existence of typical form, in the sandy spits bordering the entrance, which will in general indicate the direction of the resultant movement.

"3. The recognition of the fact that the proper place for the ebb discharge, or channel over the bar, is as far removed as may be from the point of direct attack of the flood resultant, when the direction of the latter is not normal to the coast.

"4. The definite enunciation of the principle that the trend of the coast with reference to the cotidal line will in general indicate at once the proper position for defensive works.

"5. The presentation of an original form (in plan) of breakwater, whereby the natural agencies are materially aided, without serious interference with either the flood or ebb forces.

"6. A method of improvement whereby the internal currents are concentrated and conserved for more efficient scour after passing the gorge.

"7. A plan for utilizing the natural tendencies of the flood to cut a beach channel which shall be available for the lighter-draught vessels.

"8. The enunciation of the principle that the cause of the angular movement of the ebb stream after egress is due to the general form of the exterior coast-line, which causes a racing of the tidal crests, from the outer capes towards the bight of the bay, and that the flood components thus generated are the forces which build the bars and shift the inlets. This incessant semi-diurnal action of the flood is the controlling element in the forces affecting the magnitude and position of the bar. Storms and winds may modify and shift the deposits, but eventually the flood re-establishes the original conditions.

"9. The free circulation and ingress given to the flood by the detached breakwater, so designed as both to oppose the flood and produce interfering waves which deposit sand outside of the channel, whilst it also aids the ebb in its attack on the bar by defending its channel and concentrating its volume.

"10. For a given site and stage of water, the flood movement approaches in the same direction, hence the resisting and regulating works should be placed on the near side of the proposed channel. If on the far side, they would be worse than useless, unless for shore protection.

"11. No artificial re-opening of an outlet which has been closed by this flood component can be maintained without auxiliary works to deflect and modify its action. Dredging is only justified when the interests of navigation are sufficient to maintain a continuance of the expense, and no other reasonable methods are available.

"12. The ability resulting from these general principles to construct works requiring a lesser linear development which will produce greater navigable depths at less cost.

"13. The abolition of the risks and difficulties attending the navigation of narrow jetty entrances in times of danger.

"14. It frequently happens that the requirements of navigation and tidal concentration are conflicting: the former demanding wide entrances; the latter, on account of insufficient tidal volume, narrow ones. This debars the usual jetties, and prevents improvement. The plans herein proposed are eminently adapted to meet such contingencies."

The last-mentioned condition applies in a significant way to the conditions at Absecon and other inlets.

The phenomena of tidal movements, and their bearing upon the formation and destruction of barriers in harbor basins, are of course influenced not only by the topography of the coast-line, but by that of the bottom of the harbor itself, both of which features are in turn perpetuated or changed in form by the relative resistance of the material forming the bottom of the harbor, and the direction and force of currents due to fresh water and tidal movements, winds, and waves. Yet, at the same time, little has been correctly understood as to the laws governing these movements. The new conditions which Professor Haupt so ably enunciates in his paper throw much light on the study of the history of our offshore waterways, as shown by an inspection of those extending along the Atlantic coast, as exhibited by the Coast Survey charts. This is particularly realized in an examination of our southern bay, extending from Cape Florida to Cape Hatteras, and of our middle bay, from Cape Hatteras to Nantucket. The application by Professor Haupt, of his principles and discovery to local conditions along this coast-line, is unique and forcible. It is certainly evident to an intelligent and experienced engineer, as Professor Haupt himself indicates, that, if it is proposed to aid nature, the engineer "must so design his external works as to prevent the flood-tide from carrying sand into the channel to obstruct the ebb and require more work of it for its removal." His system is based upon an internal concentration of the ebb currents in their path to the gorge, and of their external conservation after passing through this section to the ocean.

A paper narrating a discovery so important in ocean dynamics as this, cannot be fully reviewed or fairly treated in a brief space; but one of the most convincing arguments in support of the conditions enumerated above is the application of the discovery to the cause and direction of the tidal movements in Barnegat Inlet as bearing upon the location of the light-house which was erected in 1834, but which was subsequently destroyed prior to the erection of the second structure in 1858. This latter structure has been ineffectually 'protected' by a system of jetties, and it is now evident, in the light of the investigation of this particular case, that the structure has been improperly placed on the spit opposed to the flood resultant. If the light had been placed on the north spit, the interests of navigation would, no doubt, have been as well protected, and all the defensive works which have been constructed at great cost to the government would have been rendered entirely unnecessary.

Lentz, in his 'Ebb and Flow of Tides,' says, "The intricate, theoretical, tide-generating conditions are complicated by a number of circumstances, forming a bewildering labyrinth of causes and results, through which the human mind cannot find its way." When one bears in mind such a statement from an authority so high, too much cannot be said in praise of Professor Haupt's discovery in its bearing on "useful improvements relating to navigation" as well as "natural philosophy," and of the high honor conferred upon him by the American Philosophical Society in awarding him the Magellan premium.

C. A. A.

EXPLORATION AND TRAVEL.

Notes on the Geography of Labrador.

THE December number of the *Bulletin of the American Geographical Society* contains a paper by A. S. Packard on the physical geography of Labrador. The paper is accompanied by a map of Labrador, compiled by F. Leuthner, and said to show the present state of our knowledge. It is founded on the British

Some additional information is contained in the publication of the reports of the German polar stations of the international system. Since Koch's visit to Labrador, meteorological observations are being made at all missionary stations of the Labrador coast, which are of particular value as filling the wide gap between the system of Canada and the Danish stations in Greenland.

It is now almost superfluous to point out that the embryo of the highest mammals passes through stages of development closely allied to the permanent forms of groups of animals lower in the scale. But that there is also a close functional resemblance in many particulars has not been much insisted upon. The subject is so large that the various adaptations in the embryo to an environment that is but temporary can be only indicated, and not treated in detail. It is plain that the embryo of the mammal, being surrounded by a fluid medium and drawing the oxygen supplies for its tissues independently of any actual contact with an atmosphere, must resemble functionally aquatic animals proper in many respects. It breathes by the placenta, virtually as the fish and other aquatic animals by gills. The condition of the blood puts it on a par with lower forms; and, even in the highest intra-uterine stage of develop-

[illegible]

An interesting sketch of the physical geography of Labrador was given by Dr. R. Koch, who wintered in Nain in 1882-83, and visited the stations of the Moravian missionaries. He describes the country in the *Deutsche Geographische Blätter* (vol. vii. No. 2, 1884). The outlying islands are barren and destitute of vegetation; the valleys adjoining the bays and fiords, however, have beautiful forests of pine and larch, surrounding dark, quiet lakes. Towards the mountainous region the woods are lighter, and the numerous dead trunks testify to their struggle against the gales of winter. Travelling by sledge westward from Nain, the plateau of the interior is reached after four or five days' travel, of about thirty miles each, through fiord-like valleys. After one or two days more, the height of the land is reached. The height of the land approaches the shore in the northern parts of the peninsula, being only one day's journey

ment, the blood supplied to the tissues is not completely aerated, — a condition remaining in all forms lower than the birds. Many functions peculiar to the mammal, or, if not actually characteristic, but indifferently developed in lower forms, are still less marked in the mammalian embryo. If there be consciousness, it is of that obscure kind existing only in forms of life low in the scale. Reflexes, indeed, there are in abundance, and probably much nervous automatism; but such limited action of the nervous system is precisely what distinguishes lower from higher groups of animals.

Nor is the adaptation of the newly born mammal to its surroundings immediate. Throughout the first days of the life of the infant, such adaptation is very imperfect, and in consequence many children perish. Further, the resemblance of the infant to animals of lower groups is shown in many directions, and especially in the neuroses and psychoses. The study of infant psychology has of late attracted much attention, and promises most instructive results.

Turning from embryonic and infantile life to the opposite pole of existence, old age, there is much that points in the direction of reversion. It is not a matter of great importance whether we regard this as physiological or pathological. Shakspeare's unrivalled description of the epochs (biological and psychological) of human life will occur to many readers. We must not, however, push the resemblances between the infantile and senile stages too far. There is sometimes a functional likeness which can scarcely be considered genuine physiological reversion, although it is a species of functional reversion, for the consequences are the same. But in general in both conditions there is an imperfect adaptation to the environment. Moreover, in certain respects the old man reverts rather to the functional condition of lower forms of life than directly to a previous stage in his own existence. Thus the imperfect action of the respiratory, circulatory, cutaneous, and also of the nervous system, by which the functions of the cerebrum and the senses are weakened, are all either physiological or pathological reversions, as we choose to regard the matter. But it is not on such facts, however, that I would rely to establish the principles of this paper.

In the various stages of slow or natural death, we have the clearest evidence of physiological reversion in not one but many different systems of the body.

Normally expiration is largely passive, though possibly less so than the text-books of physiology have represented; but, as is well known, in the dying man this phase, and indeed all phases, of the respiratory act are in turn, or contemporaneously modified: there may be a diminution of one phase, and an exaggeration of another, etc. In the frog and turtle both inspiration and expiration are active: in such animals we recognize a function, moreover, of the mouth and pharynx, in respiration, normally unknown in man. Dr. Garland has, however, pointed out that in the tracheotomized dog, and, as he believes, in man under the same circumstances, and also in the moribund, a form of the throat respiration supervenes. He has proved this experimentally in the tracheotomized dog (*Journal of Physiology*, vol. ii.). In other words, there is a resemblance to what exists normally in the frog. Garland recognized this, though he has not spoken of it as a physiological reversion. But apart from this minor reversion, it is plain that in general the respiration of the dying bears a resemblance to that of the groups with an active phase in both halves of the act. Further, there is frequently a marked facial and laryngeal respiration, so well seen in the normal breathing of such lower mammals as the rabbit.

Accompanying this alteration in the respiration, there is a great change in the circulation. As I have shown, as the result of a special study of the subject ('The Rhythm and Innervation of the Heart of the Sea-Turtle,' *Journal of Anatomy and Physiology*, vol. xxi.), functional action ceases in the hearts of the cold-blooded animals invariably in a certain order; that is to say, the parts latest developed phylogenetically, as the ventricles, are the first to cease to act. The same applies to the mammal, and I have elsewhere ('A Physiological Basis for an Improved Cardiac Pathology,' *Medical Record*, Oct. 22, 1887) expressed the conviction that it is fortunate for man that such is the case. It is difficult to see how the ventricles could retain at once that sensitiveness and power to adapt to the ceaseless and innumerable changes in the inner life

of a mammal, and also the resistance so marked in the auricles and the great veins at their junction with the right auricle, corresponding to the *sinus venosus* of lower forms. Now, in the moribund there may be only an occasional beat of the ventricles to several of the other parts of the heart; or the ventricles may pulsate so feebly as to expel but little blood: hence the latter becomes gradually more venous, with corresponding effects in the venous channels, which become more prominent; in the nutrition, leading to lowered temperature generally most pronounced in the parts most distant from the heart; in gradual loss of all the functions of the cerebrum; finally, the only muscles that are functionally active are the respiratory, the sphincters, etc. In a word, the dying human subject sinks functionally lower and lower in the scale of animal life. There is physiological reversion of the widest kind. This seems the most instructive aspect of the facts; indeed, I can see no other way in which a really philosophical significance can be read into such phenomena.

It may be readily perceived that in sleep itself there is a daily reversion. Sleep not only reduces all human beings to the one level, but it puts all mammals on the one plane. Now, it will be seen, if we consider the nervous system, that the parts peculiar to man, or most developed in man, are the very ones that for the time being are as good as annihilated in sleep. Why should this be so? Why should this order be followed? To say that the parts of the nervous system remaining functionally active are those necessary to maintain the vital functions, in reality throws no light on the question unless we regard man as derived from lower forms, while the whole becomes clear enough if we admit this. Much the same line of argument applies to the reversions witnessed in hypnotism, somnambulism, and allied phenomena.

Hibernation is one of the most interesting examples of physiological reversion to be found. We witness in the bat, though one of the most active of animals, a return during hibernation to a condition very much like that normally present in a cold-blooded animal such as the turtle; while the cold-blooded groups themselves pass into a winter sleep allied to the quiescent state of plants or the 'resting stage' of the infusorians. Reversion alone — physiological reversion — seems to explain such behavior.

These general phenomena prepare us to understand certain results following experiment, which, so far as I know, physiologists have never explained satisfactorily. I shall take my illustration chiefly from cases mentioned in the ordinary text-books, and especially from the magnificent work of Prof. M. Foster, as in that we find subjects usually considered from different points of view.

It has been pointed out that if the nerves supplying the posterior pair of lymph hearts in the frog be divided, though their action ceases for a time, it is eventually resumed; that if the sino-auricular junction of the heart of the turtle be ligatured under favorable circumstances, the action of the auricles and ventricle, temporarily arrested, may be resumed.

In general, if the sinus, or the sinus and auricles, be ligatured off from the ventricle in a frog or turtle, and all the cardiac nerves be divided (precluding the possibility of nervous stimuli reaching them from distinct centres), these parts of the organ, I have observed, will beat more forcibly against the unusual resistance than before.

It is stated, that, when the cervical sympathetic is divided, the dilatation and cessation of rhythmic action of the arteries in the ear of the normal rabbit, ensuing, are finally followed by a return to the normal condition.

The latter has been explained by the assumption of a local nervous mechanism, which, though habitually influenced by the central nervous system, suffices of itself when the connection with the nerve-centres is severed; but such local nerve-mechanism has never been demonstrated anatomically. These and many similar cases are explicable by physiological reversion. In lower forms,¹ in which it is quite impossible to believe in a local nervous mechanism at all, there is pulsation in vessels, etc., owing to the rhythmical action of unstripped muscular fibre or of cardiac muscle. This function of the muscle is no doubt under the control of the nerve-centres in all the higher groups of animals; and when it is exhibited apart from such connection, we naturally seek for an explanation.

¹ This subject is discussed in my paper on the 'Causation of the Heart-Beat,' etc., in the *Canada Medical and Surgical Journal*, January, 1887.

To my mind, the only one adequate is to be sought in physiological reversion. Whether there are not examples of it even when the nervous system is intact, as in excessive action of the bladder, ureter, etc., in cases of obstruction, is worthy of consideration.

Dr. Pye-Smith (*Journal of Physiology*, vol. viii.) has maintained, from certain experiments made by him, that the vessels of the ear of the rabbit, etc., do not regain their tone after section of the nerves concerned, and concludes that nerves are not essential to nutrition. However it may be as to the first proposition, I cannot help thinking that the author's conclusions are broad to the verge of decided error when applied beyond the case in point.

Assuming, however, that in most instances the vessels do not regain tone, I should interpret the case as one of still more remote reversion to a condition when nerves were not required for nutrition,—a condition existing in several large groups of animals. Such a case in the mammal must be very rare, however, and is offset by thousands of facts that show that nutrition is dependent on nervous connection. It would appear that oxygen may be absorbed both from the skin and the alimentary canal; and, if we may judge by many analogous instances, this capacity would be augmented when the individual greatly needed such help, owing to imperfect action of the lungs. In such instances we have, on the one hand, a retained function operating in man to a very minor degree; but, as is now well known, in batrachians the skin is an important respiratory organ, though also one acting very much in a manner supplementary to the lungs, as circumstances necessitate. When in man the skin and alimentary canal function as respiratory organs to an unusual degree, we have physiological or pathological reversion.

It is well known that in certain pathological conditions (hysteria, etc.) large quantities of gas are secreted by the alimentary tract; nor is this so surprising when it is remembered that the digestive canal and the respiratory organs have a common origin from the same cell layers of the embryo.

If our swallowed oxygen can be absorbed by the alimentary canal, of which there is no reasonable doubt, it is plain that we retain a function discharged by an analogous organ, the air-bladder of fishes.¹ Certain groups of turtles (if not all, occasionally, as I believe) have a species of pharyngeal respiration. Oxygen is absorbed from the water gulped into the pharynx, and possibly the case of absorption of gases from the alimentary canal of mammals is still more like this than the analogous instances already mentioned; but, at all events, there is a potential capacity in the alimentary tract of man for respiratory functions which is unquestionably under certain circumstances considerably developed; and the most natural explanation is physiological reversion.

In an allied system, the renal, we have evidences of physiological reversion. In most fevers the skin is less active, and the kidneys function excessively or at least differently; the urine, though scanty in quantity, is of high specific gravity, and thus resembles more the same secretion in not only lower mammals, but the lower divisions of vertebrates. In a whole host of diseases² there is a great increase of a constituent which is but scantily present in normal urine,—uric acid. But uric acid replaces urea in fishes, reptiles, and birds; and in not a few cases in man in which the uric acid is increased the urea secretion is diminished. That man's kidneys should thus have the capacity to function in a manner analogous to those of lower forms, calls for explanation. The fact that in such cases the reversion does not wholly cover the functional disturbance arising from or giving rise to this change, is not a serious objection; for it is not to be supposed that an animal adapted to new conditions should, by any reversion to an ancestral state, escape wholly, or even in great part, the penalties of incomplete adaptation.

In the digestive system of man and other mammals we have interesting instances of physiological and pathological reversion. Regurgitation of food is normal in some birds, and I am inclined to believe that it is more common in lower vertebrates than has been as yet clearly ascertained. But the remarkable regurgitation of ruminants seems to be a specially developed function. Different groups of

animals vomit with very varying degrees of facility. There is to my own knowledge in man a tendency to antiperistalsis in the œsophagus, if not the pharynx, independent of acid eructations. Some individuals experience this when there is interference with the regularity of the action of the bowels. Cases have been reported in which there seemed to be habitual regurgitation of food, like that of birds or even ruminants. Here again the most natural explanation seems to be that the alimentary canal of mammals, including man, retains a capacity to revert to a condition existing in a higher degree in antecedent forms; or, to interpret the matter slightly otherwise, that man retains a capacity which in some lower forms has been specially developed (ruminants, etc.), and which in himself, under certain abnormal circumstances, becomes greatly developed,—facts explicable by general community of descent.

In the cases in man referred to above, the mere law of habit does not of itself suffice to explain the facts: indeed, apart from the wider laws of descent, there is very little basis for the action of such a principle; there is no fulcrum for the lever, or, at best, a very unsteady one.

In diseases of the blood or blood-forming organs we have some remarkable instances of functional reversion. Though exact quantitative determinations of hæmoglobin are wanting for most lower vertebrates, there can be no doubt that in mammals the quantity of this substance furnished to the system within a given time is much greater than in those groups requiring less oxygen for their tissues, in consequence of a feebler cell activity. But in cases of anæmia in man the quantity of hæmoglobin may be greatly diminished, one result of which is that the subject is reduced not only as regards the condition of the blood, but in several other respects, to a state bearing a more or less close resemblance to life in the lower vertebrates. There is diminished activity in the locomotor, the nervous, and other systems of the body. The subject requires rest, careful feeding, quiet of the mind, etc. The treatment is unconsciously based on this fact of reversion. It may be stated, in truth, that the anæmic subject is unable to discharge the functions which are most characteristic of man, and that he naturally deports himself like a lower form. In leukæmia there is a still more marked reversion, for the blood in this disease approaches the condition found in the invertebrates, in which, as a rule, the red blood cell or hæmoglobin in any form is wanting. This being the case, it is not surprising that the disturbance of the normal functions is so great: the marvel is rather at man's capacity to adapt at all to such unnatural conditions; which, however, is clearer on the doctrine of descent from lower forms and in the light of the conception of physiological reversion than by any other explanation.

In that form of anæmia or chlorosis due to an imperfectly developed vascular system generally, we surely have a clear instance of reversion, so marked that during the whole lifetime of the individual there may never be other than the most defective adaptation to environment.

Instances of cyanosis due to permanence of foetal conditions of the circulation, and therefore resembling those normal to the frog and turtle, are such clear cases of human reversion as only to require mention.

In cases of valvular diseases with dilatation of the heart, or indeed any condition of this organ that permits of regurgitation with imperfectly aerated blood, we have similarly a reversion. It will be found that in not a few diseases of the heart,—in the condition of that organ during fainting; after shocks which have temporarily suspended many functions of the nervous system, and in consequence greatly imperilled life,—in all such cases it will be found that those parts of the heart the earliest developed in the history of the animal series are the very parts to continue their action latest. Now, this is at once fortunate for the mammal, and of great significance, inasmuch as the latest investigations show in the clearest way that the action of the ventricles is dependent on the functional integrity of the sinus and auricles, especially of the sinus. Suppose that the reverse were the case, and the sinus (or great veins) and auricles were the first to cease pulsating: the beat of the ventricle would be of comparatively little use; but apart from this, what explanation can be given of this peculiar sequence in the mammal independently of derivation from lower forms, which makes all clear? If this doctrine of physiological reversion went

¹ See a paper by Gage in the *Proceedings of the American Association*, vol. xxxiv.

² The writer discussed the subject of uric acid in a short paper in the *Medical News* for June 27, 1885.

no further than the circulatory system, it would throw a flood of light on the significance of otherwise obscure if not absolutely inexplicable phenomena. But it is to the nervous system that we must look for evidence which places the doctrine beyond cavil to a degree perhaps not equally clear in other parts of the economy.

When a mammal is poisoned by curare, by which the nervous influences normally reaching the tissues and regulating heat-production (and, as I believe, nutrition) are wholly or partially cut off, the mammal becomes virtually a cold-blooded animal. Its temperature rises and falls with that of the ambient air. This is one clear example of physiological reversion experimentally produced. It is, however, only one of many that might be instanced. It is well-known, and can be shown in the simplest manner, that when the head of a frog is removed, reflex action is more readily excited: the same applies to the removal of the cerebral lobes of the mammal. As Goltz has pointed out, one of the most remarkable results following removal of large portions of the cerebral lobes in the dogs which this experimenter kept under observation, is, as I can myself testify, the increase of reflex action. The animal becomes a sort of machine, which one may manipulate at will. A similar result follows in man when the higher centres of the cerebrum are rendered functionally inactive by disease or injury.

Now, in all these cases the animal loses its own peculiar character, and sinks to the level of some form lower in the scale. All will agree that the higher forms of true automatic (spontaneous) action in the physiological sense are dependent on the existence of the cerebrum. It follows, therefore, that the lower we pass in the scale of life, the more machine-like animals become.

Pathological reversion is most plainly illustrated by the results of hemorrhage into the cerebrum. Dr. Hughlings-Jackson has so well described the order and relation of the various events, that I shall here quote his own words in describing lesions of the cerebrum (*corpus striatum*), from hemorrhage:—

"It will be found that those parts suffer most and suffer longest which have the more voluntary uses. This is notorious of the arm and leg: the arm nearly always suffers more, and recovers later, than the leg. Of course, the distinction into complete and incomplete hemiplegia is artificial. There are all degrees of paralysis according to degrees of gravity of the lesion. But there is an order in which paralysis increases in increasing gravity of lesions. We observe that the graver the lesion, not only are the more voluntary parts (arm and leg) more paralyzed, but that the further spread in range is the paralysis, and the method of its spreading is from the more voluntary to the more automatic parts. Thus, neglecting very small clots, a considerable lesion paralyzes only the most voluntary movements of one side of the body, those of the face, arm, and leg, and these parts in degree according to their degree of voluntary use. A larger lesion not only causes a deeper and more permanent palsy of these three parts, but it leads also to implication of more automatic parts. In still larger lesions the palsy spreads to the most automatic parts of the body, even to parts supplied by ganglionic nerves. It produces stertor from palsy of the palate and palsy of the respiratory muscles and of the heart,—the palsy of respiration and of the heart showing itself chiefly in *slowness* of movement. There is also abasement of temperature." —REYNOLDS'S *System of Medicine*, vol. i.

I have intentionally quoted the exact words of this eminent investigator of the abnormalities of the nervous system constituting disease, so that their interpretation alone may rest with me.

It being granted that the lower we pass in the scale of animal life the more machine-like or automatic does the organism become, it will be clear, that, taking the various degrees or grades of paralysis as described above, we have likewise degrees of resemblance to lower forms; i.e., the graver the paralysis, the lower in the scale must we seek to find an animal comparable to man in this condition. The slowing of the heart and the lowering of the temperature are both modes of approach to the normal functional condition in cold-blooded animals.

When we add to this, or take by itself, paralysis of the muscles of the face, by which the expression peculiar to man is lost, we have a condition plainly like that in lower mammals, and, in extreme cases, even like that of the lower vertebrates, in which facial expression as determined by muscular action is minimal.

It must be conceded that the uneducated deaf-mute is in a condition mentally much nearer that of the higher mammals than is his uneducated fellow-man in possession of all his senses. But in aphasia, the result of disease or shock, there is in man plainly a marked reversion to a condition mentally resembling that in the 'dumb-brutes' about him.

In the case of the idiot we have an example of man in many respects inferior to the higher mammals.

But it is not my intention to treat the subject of psychological reversion in this paper. The subject is at once large, tempting, and, to my mind, furnishes evidence the most conclusive for the doctrine of descent with modification from lower forms as an explanation of man's nature.

One naturally looks about for an explanation of such remarkable facts as the order of muscular failure or paralysis as indicated in the paragraph quoted above. The entire brain may be separated from the medulla in a rabbit, and respiration still continue. The lower we descend in the animal scale, the more do we find the brain reduced to a mere repository for mechanisms adapted to regulate those processes constituting the so-called vegetative functions; but the question again and again recurs, 'Why in mammals, why in man, should the functions first to fail be those peculiar to them or to him, and not the reverse?'

The longer even in the lifetime of a single individual a certain form of muscular action has been practised, the less attention is required for its performance, the less voluntary, the more automatic it becomes. But would the duration of man's existence on this planet suffice to explain, on any system of gradual progression or functional improvement, the wonderful automatic action of all of those mechanisms essential to the maintenance of life?

The doctrine of descent renders the whole plain enough; and unless we adopt the view that man appeared suddenly and independently upon the scene, fully equipped for the battle of life, it seems but rational to assume that with all his departures, both by way of progress and retrogression, his functions are what they are by reason of such relationship as we are indicating. The morphologists have done much to account for the affinities of form or structure in the animal series: it remains for the physiologists to do their part in showing how the functions of the higher animals are related to the functions of the lower.

But once accepting this position, it is possible to explain phenomena following experiments on animals, and growing out of the experiments disease is producing, or, as I would prefer to say, the phenomena which are the deviations from the normal that constitute disease. Disease is no entity in itself, though we often use language which might lead to the belief that we so conceived of it.

When the normal adaptations to environment on which the very existence of an animal depends are disturbed, what more natural than that there should be a return to a functional condition prevalent in some ancestral group, or common to a host of such groups, as the case may be?

T. WESLEY MILLS.

BOOK-REVIEWS.

Animal Magnetism. By ALFRED BINET and CHARLES FÉRÉ. (Internat. Scient. Series.) New York, Appleton. 12°.

THE nation that brought forth Mesmer, with his glittering display of charlatanry, has well atoned for this injury by bringing the study of hypnotism into general scientific recognition, and developing with a remarkable activity our knowledge of this obscure region of the human mind. Nowhere are so many men of science practically engaged in the study of hypnotic phenomena in all their various manifestations, nowhere are subjects so plentiful or so interesting, nowhere do we find so vast or so sound and constantly increasing a literature devoted to this field, nowhere else a journal devoted exclusively to the study of hypnotism, as in France. Although much that has been developed there is doubtless destined to be revised or rejected, yet the work is eminently scientific, and with few exceptions the workers have never deserted the field of painstaking, methodic study for the temptation of enlarging upon remarkable facts, liable to attract the popular imagination. The admission of a work on this subject into the International Scientific Series is therefore eminently fitting, and it is also right that the work thus honored should come from Paris, and more particularly

from two pupils of Charcot, to whom, more than to any other single person, the admission of hypnotism as an accredited scientific proceeding is due.

The work itself is very well arranged, and introduces for the first time to English readers a fairly complete account of the modern studies in hypnotism. Our literature in this field is mostly concerned with the proofs of the genuineness of the states and accounts of remarkable performances, to the exclusion of the systematic study of the symptoms. The opening chapters are devoted to a concise history of hypnotism since Mesmer. The fate of this pretentious adventurer is full of interest. Mesmer appeared with his gigantic presumption, and offered a series of dogmatic propositions about the magnetic fluid coursing through the universe and influencing men. He next demonstrated to the satisfaction of the wealthy and frivolous Parisians the curative powers of this fluid. And his success was unparalleled; but, like that of most adventurers, his downfall was equally hurried. In 1784 a commission, including among its members Franklin, Bailly, and Lavoisier, was appointed to examine into the phenomena; and with commendable good sense they demonstrated the utter baselessness of Mesmer's pretensions, and ascribed all that occurred to the action of the imagination in nervously disposed individuals. Again and again is this same process repeated. A bold experimenter claims to have performed some remarkable feat; a commission is appointed, finds the pretension unwarranted, and dismisses the whole topic. A valuable prize was for several years open for any one who could read with a bandage across his eyes, as several subjects claimed to do, but no one ever successfully passed the tests. At last the scientific men were forced to the conclusion, that, while the more remarkable of the phenomena were probably exaggerated, enough remained to merit a real investigation, and that to refer every thing to the action of the imagination was no real explanation at all. This recognition was all that was necessary to give the impulse to the study of hypnotism as a more or less morbid manifestation of the nervous system.

The next chapters are devoted to the methods of producing the several kinds of hypnosis and the symptoms of the several stages. Here the authors follow Charcot's well-known three states, — lethargy, catalepsy, and somnambulism. These states are marked off from one another by distinct physical symptoms, and, though we have no satisfactory explanation of the reason why the raising or closing of the eye should cause certain subjects to pass from one to the other, yet the phenomena seem well enough established to be accepted as empirical facts. Again, the stages are found pure and typical only in hysterical hypnosis; and many subjects exhibit only one or two stages, and the symptoms manifested frequently diverge from what is here considered typical. The account of the symptoms is largely restricted to the more purely physical ones, which, though less striking, are much more convincing and valuable to the scientist. The writings of the pulse and the respiration, and of the curve of muscular fatigue, are figured, and speak more plainly than pages of description.

The psychological process most admirably illustrated by hypnotic subjects is that of suggestion, and to this Binet and Féré wisely devote a liberal portion of their pages. This process is simply unusually active in the hypnotic subject: it is exemplified daily in the influence of a strong-willed person over a weaker, of the teacher over the scholar; in short, "we have only to glance at social relations in order to see that individuals fall into two categories, — the leaders and the led; that is, the givers and the recipients of suggestions." These suggestions can be taken up by any of the senses, and, in brief, suggestion may be defined as the execution of an act through the intervention of the psychic faculties, the original impulse coming from another individual. One school of students of hypnotism (often known as the School of Nancy) regard all the facts observed in hypnotic states as due to suggestion, conscious or unconscious; and their explanation of such phenomena as the action of a magnet in transferring sensations from one side to the other, of the supposed action of drugs at a distance, of mind-reading, is that these effects are due to the unconscious suggestion of the results by the operator. The hypnotic state makes the subject keenly on the alert for the remotest hint; and many cases where the expected has been guessed at with a remarkable shrewdness, far beyond the capabilities of the subject in a normal condition, are on

record. The Paris school, on the other hand, regard suggestion as applicable to only a portion of the phenomena, and hold that certain purely physical symptoms are produced with which consciousness has nothing to do. For example: the methods of inducing sleep by passes, intense fixation, etc., the Nancy school regard as devices for impressing the mind of the subject with the idea that he is to be hypnotized, and that the same results follow from any signal to which the subject is accustomed; while the Paris school regard these physical manœuvres as of peculiar efficiency and influence upon the nervous system. Both schools agree that the process of suggestion is the key to a majority of the more striking hypnotic phenomena, and that a knowledge of the possibilities of suggestion is indispensable to every student of what is now termed 'psychic research.'

The chapter dealing with hypnotic hallucinations is full of interest. The instances of unilateral hallucinations, in which only one-half of the body, one eye, one ear, or whatever it may be, has responded to a suggestion, lead one to connect with them the theories regarding the action of the two halves of the brain. An important part of the investigation concerns itself with the genuineness of these hallucinations, for this is the field where simulation is to be guarded against at every step. Binet and Féré have elaborated a series of tests, which leave no doubt as to the conclusion that these induced hallucinations are real in every sense. If they are visual, as most of them are, they are doubled and refracted if a prism be interposed between the eyes of the subject and the imaginary image; the image is enlarged or grows smaller, as the right or the wrong end of an opera-glass is put to the subject's eyes; and so on. Another interesting type of hallucination occurs when the subject conjures up from a blank card a picture or portrait at the command of the operator. If the card be inverted, the supposed picture is seen upside-down: if another precisely similar blank card is substituted, the change is instantly detected, for the imaginary picture vanishes. The explanation is, that the abnormally keen sight of the subject has detected upon the apparently uniform surface some little mark, some trifling irregularity, and that this is sufficient to arouse the suggested image. This view is supported, to mention one fact of many, by the observation that at a great distance the subject no longer distinguishes between the card with which her hallucination was connected and other blank cards, while, if an opera-glass be given her, the image is again aroused when the right card is shown.

Under the term 'psychic paralysis,' the authors bring together a most interesting series of facts, which would perhaps be more fittingly viewed as psychic inhibitions. The type of the psychic process here specified is easily made clear. A subject is given the suggestion that a certain person in the room is invisible. From that moment on, she does not see him. If he places himself in her way, she tries to avoid him, but is sorely perplexed to understand the nature of the obstacle. A hat placed upon the gentleman's head is to her mysteriously suspended in the air, and so on. Now, in all such processes the subject sees every thing else: she has not been made blind, and the image of the invisible individual striking upon her retina makes her see him, in a sense. But the orders have been issued from the cortex that when such and such an image is impressed upon the retina, it shall not be converted into a sensation. While consciousness is at home, it is not at home to that particular sensation; or, as another writer has expressed it, it is the process we make use of when we cut a friend in the street. It is not that we do not see him, but that we make ourselves believe as far as possible that we do not see him. This process (though it is not so original with the authors as they claim) is sure to yield interesting results from future study.

The final chapters of the work deal with the question of the therapeutic value of hypnotism, its relation to the problems of responsibility, and so on. On all these topics the authors hold very sound opinions, and are as keenly alive to the dangers and possible abuses of hypnotism as they are to its importance as a department of experimental psychology or as a curative agent.

The volume can be warmly recommended to all anxious to acquire a familiarity with the most truly scientific work in this field, although it represents only one of many equally able productions of the French school. It should also be remembered that the authors

are to some extent partisans of a definite school of hypnotism, and that some of the phenomena upon which they lay stress would be otherwise interpreted by other workers, or even entirely discredited. About nothing is this caution more necessary than the results these authors describe as due to the action of the magnet. As long as it has not been proved that the normal nervous system is to the slightest degree subject to magnetic influence, it seems premature to have it play so great a part in the observation of hysterical hypnotics; and the more so, as the same results have been obtained by suggestion; and, in so far as this has been ruled out, the results have failed to follow with other experimenters.

Lectures on Bacteria. 2d ed. Tr. by H. E. F. Garnsey. Rev. by I. B. Balfour. New York, Macmillan. 12°. \$1.50.

THIS book is a translation of De Bary's 'Vorlesungen über Bacterien,' and, as Dr. Balfour states in his preface, has been prepared because there is at present no book in English which gives in like manner a general view of the subject of bacteria. It sets forth the known facts in the life of bacteria in their connection with those with which we are acquainted in other branches of natural history. The second edition of De Bary's lectures appeared in October, 1886; so that we have the researches into this abstruse field of science brought down to a very recent date. In the introductory chapter the author considers the position which bacteria occupy in the vegetable kingdom among the fission-fungi or *Schizomycetes*, and their structure. He then defines the meaning of the terms 'coccus,' 'bacterium,' and 'spirillum.' In speaking of these three forms, he says that they are so exactly represented by a billiard-ball, a lead-pencil, and a corkscrew, that no one requires for his instruction the costly models which are offered for sale.

The course of development of bacteria, and the distinction between the endosporous and arthrosporous groups, next receive attention. From this the author passes on to the consideration of the much-mooted question of whether there are specifically distinct forms, species of bacteria, and, if so, how many such species can be determined. In treating of this interesting topic, he says that species are determined by the course of development, and defines the term 'species' as the sum-total of the separate individuals and generations which, during the time afforded for observation, exhibit the same periodically repeated course of development within certain empirically determined limits of variation. In the list of those who believe that the bacteria may be distinguished into species, are Leeuwenhoeck, their discoverer, Ehrenberg, and Cohn. Among those who deny this, and who consider that the observed forms proceed alternately from one another, the one being converted into the other with a change in the conditions of life, are Billroth, who, in a publication issued in 1874, included all the many and various forms which he had examined in one species, which he named *Coccobacteria septica*; and Nägeli, who has supported the same views since 1877. Nägeli says that he finds no necessity for separating the thousands of bacterium-forms even into two species, but that it would be rash to speak decidedly on a subject that is so imperfectly explored. But he also says, that, if his view is correct, the same species, in the course of generations, assumes a variety of morphologically and physiologically dissimilar forms one after another, which, in the course of years and decades of years, at one time turn milk sour, at another give rise to butyric acid in sauerkraut, or to ropiness in wine, or to putrefaction in albumen, or decompose urine, or impart a red stain to food-material containing starch, or produce typhus, relapsing-fever, cholera, or malarial-fever. In commenting on this view of Nägeli's, De Bary truly says that our practical interests require that we should obtain a decided answer to the question of species; for it certainly is not a matter of indifference in medical practice, for example, whether a bacterium which is everywhere present in sour milk or in other objects of food, but without being injurious to health, is capable or not of being changed at any moment into a form which produces typhus or cholera. The scientific interest demands that the question should be set at rest. The opinion to which De Bary himself comes, in reference to this important question, is that it may safely be maintained that continued investigation has at length arrived at the decision that there is no difference, as regards the existence of species and their determination, between this and any other portion of the domain of natural

history, and that species may be distinguished provided the course of development is followed with sufficient attention. The origin and distribution of bacteria, their vegetative processes, the effects of temperature and the presence or absence of moisture upon them, and the subjects of culture, disinfection, and antiseptics, are discussed by the author, but lack of space prevents us from following him into these subjects in detail.

One of the most interesting chapters in the book is that which treats of the causal connection of parasitic bacteria with infectious diseases, especially in warm-blooded animals. De Bary regards as proved the causal connection between the *Spirochæte obermeieri* and relapsing-fever, Koch's bacillus and tuberculosis, Neisser's gonococcus and gonorrhœa, and Koch's spirillum and Asiatic cholera. Among the diseases due to the action of bacteria, he reckons also traumatic infectious diseases, affections incident to child-bearing, and others connected with the formation of groups of ulcers, abscesses, and boils. He does not think that we have any precise determination of the nature of the contagium or miasma virum of malaria. The relation of bacteria to typhoid-fever and diphtheria in men, he regards as uncertain, notwithstanding Goffky's and Löffler's model investigations. The concluding chapter of De Bary's admirable *résumé* is concerned with the discussion of the diseases caused by bacteria in the lower animals and in plants, while this is followed by a conspectus of the literature of the subject, and notes on the text. The whole volume is admirably arranged, and we know of no book which gives so concise and at the same time satisfactory an account of bacteria as the one before us. It is well translated; and its revision by Dr. Balfour, who is professor of botany in the University of Oxford, is a sufficient guaranty of its scientific accuracy.

Catalogue of the Pedagogical Library, Philadelphia. Philadelphia, Board of Education. 12°.

WHEN Superintendent MacAlister went to Philadelphia from Milwaukee four or five years ago, he saw and felt the need of having at his command the best authorities on the history, science, and art of education. The Board of Education appreciated the need, and by liberal appropriations it has been made possible for Mr. MacAlister to get together the volumes for which he has now printed a catalogue. Naturally, he has only selected from the field of educational literature, and has made no attempts to cover it in all its extensiveness. What he has gotten together is a good working pedagogical library, and "it is believed that the selection made furnishes the essentials for a pretty thorough study of the history and theory of education in the past, as well as ample materials for dealing with the living questions of our own time." Therefore it is that this catalogue, while referring to this one collection only, really serves as a carefully selected bibliography of pedagogics. In this respect it is far more useful than that of Messrs. Hall and Mansfield, published a year or two ago. That is too diffuse to be really useful, and it is disfigured by hundreds of mistakes and typographical errors. We trust that professor MacAlister has printed a sufficiently large edition of his catalogue to permit its general sale.

Natural Resources of the United States. By J. H. PATTON. New York, Appleton. 12°.

THE present volume is a concise review of the resources of the United States, compiled from the publications of the various National and State departments, and from private information obtained from the State governments. Therefore the data are presumably, as a rule, reliable; and as the book deals not only with the mineral resources, but comprises others also, it will be found handy as a brief review of the whole subject. 324 of the 523 pages of the book are taken up by a report of the mineral resources, on which D. T. Day treats in his annual summaries. This part is followed by notes on mineral springs and health resorts. The following sections, dealing with the vegetable products of the United States, grain, fibre plants, and timber, are very superficial; that on grasses, such as are the basis of American stock-raising, is even more so, the whole subject being treated in nine pages.

In the book we find a considerable number of remarks on physical geography which show that the author's knowledge of this subject is not very extensive. The authorities he quotes for his views

are not those which are recognized by modern science. Maury's 'Physical Geography of the Sea' is not in accordance with the views held nowadays; neither are primers on geography good authorities. It is meaningless to say that the valley of the Mississippi 'greets the south,' as its slope is southward. The author would have us believe that this southward exposure affects its climate, while practically it has no influence whatever. Passages like this are numerous in the book. On the whole, it may be considered a fair account of the subject, sufficient to meet the wants of the general reader, although the author's teleological views lead him to a considerable number of statements which will not be conceded by scientists.

NOTES AND NEWS.

PROF. ANTON DE BARY died at Strassburg on Jan. 19, aged fifty-seven years. He had been suffering for several months of carcinoma of the face, and had undergone an operation, but without recovering. He had held the chair of botany at the University of Strassburg since 1872, being called there from Halle. He had studied botany at Berlin under Alexander Brown, and was made professor of botany at Freiburg at an early age. His first publication, 'On the Fungi causing "Rusts" and "Smuts,"' in 1853, attracted much attention. While the anatomical methods of other authors had somewhat increased our knowledge of the *Thallophytes*, De Bary's method of tracing their life-history opened a new era in this study. For a few years he was engaged in studying certain algæ, but he soon returned to his favorite study, that of fungi. In 1864 he published the first number of the *Beiträge zur Morphologie und Physiologie der Pilze*, which was followed in 1865 by further studies on parasitic fungi. Here he traced the whole life-history of several parasitic fungi from their entrance into the host through all the various stages. He showed that the 'rust' of the wheat is identical with the *æcidium* of the barberry, and thus was the first to prove the occurrence of heterœcism. These observations and their startling results led to the extensive study of cultures which has been carried on so successfully since that time. In 1866 De Bary brought out the first edition of the 'Morphologie und Physiologie der Pilze, Flechten und Myxomyceten,' the second edition of which, thoroughly revised and brought up to date, was published in 1884 as 'Comparative Morphology and Biology of the Fungi, Mycetoza, and Bacteria.' Both these editions were the standard books on the fungi, and gave for the first time a comprehensive review of the subject, much of their contents being the results of De Bary's own studies. The third number of his *Beiträge* appeared in 1870; but at the same time he published numerous memoirs, among which we mention that on the epidermis in the *Botanische Zeitung*, of which he had become editor after Von Mohl's death. Since 1866 he has been working on the 'Comparative Anatomy of the Ferns and Phanerogams,' but it was only in 1877 that the results of his researches were published, — a monument of De Bary's faculties of observation, his accuracy and extensive critical reading. The influence of this book in the botanical world has been enormous. In 1885 appeared his 'Lectures on Bacteria' in the form of a book. While the style of this book is attractive and clear, it abounds in new facts brought to light by De Bary's researches, among which the study of the development of the spores of *Bacillus Megaterium* takes a prominent place, and gives a comprehensive and critical review of the whole literature of the subject. As a teacher he was eminently successful, and the influence of the Strassburg school upon the development of botany and biology has been very great. Although he was not a brilliant lecturer, he knew how to excite the enthusiasm of students who worked in his laboratory; and all who worked under his direction were so impressed with the truthfulness of his nature, his justice, modesty, and kindness, that so long as his pupils live he will not be forgotten.

— In his bulletin for December, 1887, Mr. J. R. Dodge, statistician of the Department of Agriculture, has an interesting note on the British wheat-supply for the last fifteen years. Great Britain absorbs a large portion of the wheat-supply of the world, and, if it is determined where its supply comes from, we ascertain thereby

where a surplus of wheat is grown. Since 1874 the largest national product has been that of the United States. France comes second, although she imports more than she exports, and India third. Russia occupies the fourth position. By analyzing the official statistics of Great Britain, we find where the needed wheat has been obtained, and in what proportion each source of supply has contributed. From 1872 to 1886 inclusive, the United States has furnished in grain and flour 51.1 per cent, and for eleven months of 1887 the proportion has increased to 64 per cent. Russia in fifteen years averaged 13.6 per cent of the whole, and for 1887 only 5.4 per cent. India contributed an average of 7.9 per cent, and for 1887 11.3 per cent, which is the smallest percentage in the last five years, and a marked decline in absolute quantity from the previous year. Australasia fluctuates greatly in its contribution, averaging 3.9 per cent for fifteen years, and less than 2 per cent for the sixteenth. These three competitors of the United States have together furnished only 25.4 per cent, — less than half as much as this country during fifteen years, and a much smaller proportion in 1887.

— Mr. William Ellis, president of the Royal Meteorological Society, reviewed, in his recent annual address, the work and object of the society, which, although unable to carry out expensive original or experimental work, has a considerable influence upon the development of the science of meteorology. Mr. Ellis remarked that the society has succeeded in inciting volunteer workers throughout the country to united action, of which one recent example was the ready response to the request of the society for photographs of lightning, an excellent collection of which had been obtained, and which would shortly be exhibited; in addition to which, arrangements were being made for the more systematic observation of thunder-storms. Referring to the question of sympathetic relation between sun-spots and magnetism and meteorology, he thought that any complete treatment of the question in its meteorological aspect seemed to require that it should be dealt with in a much more comprehensive manner than before, for which purpose observations more completely covering the surface of the globe might be necessary, if indeed not necessary also for the solution of many other meteorological questions, the present meteorological stations being distributed over the earth in such isolated clusters. The attention given to synoptic charts was most important, but the general meteorological characteristics of places should also still continue to be studied. After remarking upon other matters, he laid before the meeting tables showing the monthly means of amount of cloud from observations made in three different series at the Royal Observatory, Greenwich, extending in all from 1818 to the present time. In concluding, Mr. Ellis said that at one time the science of meteorology seemed likely to form an exception to the general rule of advance, for, more than any other, it has required the united action of many workers; but the field of inquiry of late years opened out allows us already to talk of the new or modern meteorology, — phrases typical of the advance achieved, although the knowledge gained seems only to remind us of how much has yet to be done. The Royal Meteorological Society has at present five hundred and twenty-two members. Dr. William Marcet was elected president for the ensuing year.

— A firm in Yokohama, Japan, is now manufacturing the excellent Auzoux models of human anatomy at low prices, as a correspondent learns by private letter.

— In *Science* of Feb. 3, p. 57, 1st column, 21st line from bottom, 'thallophytes' should read 'protophytes.'

— In *Science* of Feb. 10, p. 67, 1st column, 35th line, 'Herndon' should read 'Heudon,' as also throughout the paragraph.

— In *Science* for Feb. 10, p. 69, 2d column, 27th line from bottom, '\$2' should read '\$1.'

— Leaflets Nos. 7 and 8 in the series issued by the Industrial Education Association (9 University Place, New York City) have reached us. No. 7 is an able and concise paper on the scientific treatment of education, and No. 8 gives an account of progress in the New York City schools in 1887. This series is having a large circulation, and doing great good; for the phenomenally low price

— one cent each, or two cents postpaid — at which these leaflets are issued put them within the reach of all who care to keep posted as to educational progress in any part of the world.

LETTERS TO THE EDITOR.

* * * Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

Twenty copies of the number containing his communication will be furnished free to any correspondent on request.

The editor will be glad to publish any queries consonant with the character of the journal.

The Scientific Swindler Again.

A YOUNG man of gentlemanly bearing, who calls himself Dr. S. M. Gutmann, and claims membership in the American Chemical Society, has been lately imposing on various members of the scientific fraternity in New York and vicinity. He claims to be a pupil and son-in-law of Professor Hofmann of Berlin, and shows letters purporting to come from some well-known persons, who recommend him as an expert in the manufacture and analysis of coal-gas. He is familiar with the names of chemists and physicists in this country, and uses them with freedom by way of introduction to strangers. He represents himself to be in pecuniary straits, as the result of long and fruitless efforts to obtain employment since his arrival in this country.

Since there are many readers of *Science* whom he will attempt to victimize, it may be well to warn them against this plausible and mendacious vagabond.

W. LECONTE STEVENS.

Brooklyn, Feb. 10.

Psychics, or the 'New Psychology.'

THE 'new psychology' is a term I have noticed cropping up of late, used as the expression, the 'new chemistry,' or any similar phrase, might be to indicate a late and advanced state of a science, such as may properly bear out the word 'new' in comparison with an old or former less-advanced stage of evolution of a given subject. Referring to several dictionaries at my elbow, I find the word 'psychics' defined as 'the same as psychology,' and marked '[Rare.]' in one of them.

In this connection, I beg leave to quote a sentence from a little treatise on psychics entitled 'Can Matter Think?' published in 1886, where I say (p. 29), "I have said what I think the excellent word 'physiology' should really mean. But I wish that the sadly abused term 'psychology' could be rooted out of the dictionary, or consigned to the same limbo where 'theology' has already been put by sound science and wise philosophy. 'Psychology' means any thing, from the vagaries of superstitious spiritualism to a system of mental philosophy or a code of metaphysics. As we have the good word 'physics' for all the physical or rupo sciences, I should like to see 'psychics' replace psychology, with the distinct understanding," etc.

What I mean by this word is precisely what seems to be implied by the expression 'the new psychology;' and many may be inclined to agree with me, that 'psychics' is a short, handy name which commends itself, or, so to speak, carries its own credentials.

A *propos* of words, did not *Science* (or was it *Literary World* of Boston?) discuss lately the propriety of the adjective 'sciential' as a desirable new coinage to characterize any thing pertaining to science? If so, it may not be generally known that 'sciential' is Miltonian, as in the lines, —

"But first, low reverence done, as to the power
That dwelt within, whose presence had infused
Into the plant *sciential* sap."

Paradise Lost, ix. 837.

— where the meaning is 'science-making' or 'productive of knowledge,' — exactly what 'scientific' literally means, though such literal sense is not implied in the ordinary usage of the word, which 'sciential' was proposed to replace.

ELLIOTT COUES.

Washington, D.C., Feb. 13.

The Expansion of Pine Wood through Absorption of Water.

DURING the summer of 1886, while seeking for a method for securing a measure of the soil moisture, I conducted an experiment to discover the amount and rate of the expansion in a section of white pine wood in passing from a state of complete saturation to one of complete dryness. While looking over my notes, I find the data, and, as the experiment was carefully performed, have thought that possibly the results may be worth putting on record. The results secured were as follows:—

Date. (1886.)	Weight of Section. (Grams.)	Per Cent of Water, calculated on Dry Weight.	Length. (Inches.)	Per Cent of Expansion, calculated on Dry Length.
Aug. 22	505.0	22.76	11.12	5.30
" 23	475.4	17.91	11.12	5.30
" 24	54.4	12.70	11.10	5.11
" 25	440.5	9.25	11.08	4.92
" 26	428.5	6.27	11.02	4.37
" 27	423.7	5.08	11.02	4.37
" 28	412.7	2.35	10.84	2.46
" 29	407.9	1.16	10.68	1.14
" 30	407.9	1.16	10.68	1.14
Sept. 1	403.2	—	10.56	—
" 2	403.2	—	10.56	—

A section two inches in length was sawed off from the end of a sound, unchecked, white pine board, one and one-eighth inches thick, and of such a width that the section when completely dry was 10.56 inches long. The section was then immersed for thirteen days in a tank containing spring water, of which the temperature was about 60° F., to secure saturation. It was then exposed to the air of a dry room, and its weight and length noted daily until it ceased to lose weight, after which it was placed in a drying-oven and completely dried.

E. S. GOFF.

N.Y. Agric. Exper. Station, Geneva, Feb. 9.

Queries.

28. FLOATING DROPS VERSUS FLOATING NEEDLES. — In order that drops of water may float on the general surface, there must be entire absence of any thing which might diminish surface-tension. But the text-books, even the last edition of Ganot's 'Traité de Physique,' direct us to slightly grease needles before dropping them upon the water. Stanley, on p. 49 of his book on fluids, asserts that a polished steel wire one inch long and five-hundredths of an inch in diameter just floats if thoroughly cleaned with caustic potash and wiped dry to prevent oxidation. He says, "If there was the smallest particle of grease upon the wire, a much less diameter only would be supported." And in the same book are experiments to prove that a wire should be wetted in order to float. It may be that slightly greasing a needle does more good by smoothing over an imperfectly polished surface, than harm by diminishing surface-tension; but the phenomenon of floating drops appears to me to confirm the statement in quotation-marks above. Will some one kindly inform me where I can find a discussion of the statements of Stanley on this subject?

F. C. VAN DYCK.

New Brunswick, N.J., Feb. 11.

Answers.

20. STAR OF BETHLEHEM. — Three distinct objects have been confounded in the public mind; viz., the planet Venus, Tycho's new star of 1572, and the apparition called the Star of Bethlehem. The brilliant object visible in daylight was Venus. Tycho's star was visible in the north in the constellation of Cassiopeia in 1572, and has been thought by some, on the slenderest evidence, to be a variable of long period, which might re-appear about this time. A good account of it is found in Humboldt's 'Cosmos,' Vol. III. Chapter IV. For an account of the theories about the Star of Bethlehem, consult the unabridged edition of Smith's Bible Dictionary, Vol. III., under the heading, 'Star of the Wise Men.'

H. A. HOWE.

University of Denver, Feb. 4.